SAMPLING AND ANALYSIS PLAN
FOR
RED AND BONITA MINE REMOVAL
SILVERTON, SAN JUAN COUNTY, COLORADO

Prepared for
UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
Region 8

Prepared by
WESTON SOLUTIONS, INC.
Region 8 Superfund Technical Assessment and Response Team

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For approval signatures, see Worksheet 1 & 2.

Project Dates of Sampling:	July to September 2015
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SAP Revision Log

Site: Red and Bonita Removal
OSC: Steven Way
TDD: 0001/1502-04

Date	Revision Number	Reason for Change of Scope/Procedures	SAP Section Superseded	Requested By	Approved By

List of Acronyms

AES	Atomic Emission Spectrometry
ARSG	Animas River Stakeholders Group
ASTM	American National Standards Institute
BLM	U.S. Bureau of Land Management
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
COC	Chain-of-Custody
COR	Contracting Officer Representative
CRQL	Contract Required Quantitation Limits
DRMS	Division of Reclamation Mining and Safety
EDD	electronic data deliverable
EPA	United States Environmental Protection Agency
ERRS	Emergency and Rapid Response Services
ERT	Environmental Response Team
ESAT	Environmental Services Assistance Team
GPM	gallons per minute
GPS	Global Positioning System
HASP	Health and Safety Plan
ICP	inductively coupled plasma/mass spectrometry
L	liter
LLCCV	low level continuing calibration verification
mL/L	milliliters per liter
MS	matrix spike
MSD	matrix spike duplicate
NA	not applicable
OSC	EPA On-scene coordinator
PPE	personal protective equipment
PSI	pounds per square inch
PT	proficiency testing
PTL	Project Team Lead
QA	quality assurance
QAPP	Quality Assurance Project Plan
QC	quality control
SAP	Sampling and Analysis Plan
SOP	Standard Operating Procedure
START IV	Superfund Technical Assessment and Response Team 4
TAL	Target Analyte List
TBD	to-be-determined
TDD	Technical Direction Document
µg/L	micrograms per liter
UFP-QAPP	Uniform Federal Policy-Quality Assurance Project Plan
WAM	Work Assignment Manager
WESTON	Weston Solutions, Inc.
WQS	Water quality standard

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Introduction

This Sampling and Analysis Plan (SAP) identifies the data collection activities and associated QA/QC measures specific to the Red and Bonita Removal site (the Site) located near Silverton, San Juan County, Colorado. All data will be generated in accordance with the quality requirements described in the Quality Assurance Project Plan for Region 8 CERCLA Removal and Emergency Response Activities in Colorado, Utah, Wyoming, Montana, North Dakota, and South Dakota (Weston 2013). The purpose of this SAP is to describe site-specific tasks that will be performed in support of the stated objectives. This SAP will reference the QAPP for generic tasks common to all data collection activities including routine procedures for sampling and analysis, sample documentation, equipment decontamination, sample handling, data management, assessment, and data review. Additional site-specific procedures and/or modifications to procedures described in the QAPP are described in the following SAP elements.

This SAP is prepared, reviewed, and approved in accordance with the procedures detailed in the QAPP. Any deviations or modifications to the approved SAP will be documented using the SAP Revision Form. This SAP is produced in accordance with the UFP for QAPPs and consists of the site-specific UFP Worksheets from the QAPP.

Project Organization and Team

Refer to the QAPP Worksheet 3 & 5, and 4, 7, & 8 for the program organizational chart, communication pathways, personnel responsibilities and qualifications, and special personnel training requirements. Project-specific information is provided below.

The following are key individuals identified for this project:

Name	Title/Role	Organization	Receive Copy of SAP?
Steven Way	OSC	EPA	Y
Elliott Petri	Project Team Lead	START	Y
Jan Christner	Principal Engineer	START	Y
David Robinson	Project Manager	START	Y

The individuals who will receive a copy of the Program QAPP are specified on QAPP Worksheet 3 & 5 (Project Organization and QAPP Distribution) as noted by the asterisk symbol adjacent to their names. The program QA Manager (QAPP Worksheet 4, 7 & 8) and the Project Manager will maintain the approved QA project plan consisting of the Program QAPP, Project SAP and SAP Document Review Crosswalk. The PTL will distribute the most current copy of the project QA documents via electronic or hard copy, as directed by the OSC. Files for this project will be kept in accordance with Section H.20 of Contract No.: EP-S8-13-01, stating a length of 10 years from close of the project or end of litigation.

QAPP Reference

Weston Solutions, Inc. 2013. Quality Assurance Project Plan for Region 8 CERCLA Removal and Emergency Response Activities in Colorado, Utah, Wyoming, Montana, North Dakota, and South Dakota. Prepared for the START IV Contract. July 2013.

Worksheet 1 & 2 — Title and Approval Page

(UFP-QAPP Manual Section 2.1)
(EPA 2106-G-05 Section 2.2.1)

1. Project Identifying Information

a) Site Name/Project Name: Red and Bonita Mine Removal

b) Site Location/Number: Silverton, San Juan County, Colorado

c) Contract/Work Assignment Number: EP-S8-13-01/TDD 1502-04

2) List Plans and reports from previous investigation relevant to this project.
URS Operating Services, Inc. 2010. Red and Bonita Mine Remedial Action Field Sampling Plan. Oct 2010
Weston Solutions Inc., 2014. Sampling and Analysis Plan for Red and Bonita Mine. Nov 2014.

Lead Investigative Organization's SAP Author: Elliott Petri / START Project Engineer
Printed Name/Title

_____
Signature/Date

Lead Investigative Organization's Project Team Leader: Elliott Petri / START Project Engineer
Printed Name/Title

_____
Signature/Date

Lead Investigative Organization's Technical Manager: David Robinson/WESTON Response Coordinator
Printed Name/Title

_____
Signature/Date

Federal Regulatory Agency OSC: *Steven Way*/OSC
Printed Name/Title

_____
Signature/Date

Federal Regulatory Agency Delegated Approval Officer: _____
Printed Name/Title

_____
Signature/Date

Document Control Numbering System: W0217.1F.00458

Worksheet 9 — Project Planning Session Summary

(UFP-QAPP Manual Section 2.5.1 and Figures 9-12)
(EPA 2106-G-05 Section 2.2.5)

Date of Planning Session: 4/23/2015 **Location:** Conference call **Purpose:** Outline site prep work				
Name	**Title/Role**	**Organization**	**Phone No.**	**E-mail Address**
Steven Way	OSC	EPA	303-312-6723	Way.steven@epa.gov
Elliott Petri	Engineer/ PTL	START	303-729-6156	Elliott.petri@westonsolutions.com
Jan Christner	Principal Engineer	START	505-797-1154	Jan.Christner@westonsolutions.com

Notes/Comments: Discuss pond expansion calculations, flocculant and caustic needs, and overall 2015 site work.

Consensus Decisions Made:

- WESTON will prepare a sampling plan, calculate flocculant and caustic requirements, designate caustic and flocculant injection systems, plan and oversee retention pond expansion, operate water treatment injection systems, collect water quality samples, document site activities, and provide on-site technical support as needed during the water treatment system installation and operation, mine entries, and bulkhead installation.

Action Items:

Action	Responsible Party	Due Date
Develop SAP	Elliott Petri	Draft May 19th, 2015
Develop Health and Safety Plan	Elliott Petri	Draft May 19th, 2015
Provide conceptual design for pond expansion within limited available space	Elliott Petri	Sent before meeting
Estimate caustic and flocculant requirements and delivery systems	Elliott Petri	May 15th, 2015
Prepare action plan designating site tasks and responsibilities	Elliott Petri	Draft May 19th, 2015
Provide site assistance	Elliott Petri and additional START members as needed.	July – September 2015

Worksheet 10 — Conceptual Site Model

(UFP-QAPP Manual Section 2.5.2)
(EPA 2106-G-05 Section 2.2.5)

- **Problem Definition**

  The Red and Bonita site consists of a mine adit and waste rock pile in the Cement Creek watershed. The mine discharges metals-laden water at a flow rate of approximately 300 gallons per minute (gpm). The water flows over a steep waste rock pile, passes through a culvert under a roadway, then flows toward Cement Creek, which discharges to the Animas River in Silverton, Colorado.

  EPA and Colorado Division of Mining Reclamation and Safety (DRMS) will be entering the mine during the field season of 2015 to clean out accumulated solid precipitates prior to installing a bulkhead to eliminate discharge from this mine adit. During the previous mine entries, acid mine drainage and associated solids that were discharged from the mine were treated, settled in the retention pond, and discharged. During this work, the water will be directed to the retention pond to allow precipitate to settle prior to discharge to the traditional flow path.

- **Background Information/Site History**

  The Red and Bonita Mine is in the Cement Creek watershed, which originates high in the rugged San Juan Mountains of southwestern Colorado near the San Juan County and Ouray County line on the south slopes of Red Mountain Number 3 and the north slopes of Storm Peak.

  The rugged and relatively inaccessible western San Juan Mountains were first prospected in the area around Silverton in 1860. The extension of the railroad from Silverton up Cement Creek to Gladstone in 1899 encouraged the mining of low grade ores, and the establishment of a lead-zinc flotation plant in 1917 allowed for the treatment of the low grade complex ores found in the area. Over a 100-year period between1890 and 1991, mining activities in the upper Animas River Basin, including Cement Creek, produced the waste rock and mill tailings sources from which contamination spread throughout the surface water pathway. Over 18 million tons of ore were mined from the Upper Animas River Basin area, with more than 95 percent of this being dumped directly into the Animas River and its tributaries in the form of mill waste. Older waste rock piles and stope fillings were reworked and sent to mills as technology allowed lower grade ores to be processed economically. A great deal of abandoned waste was also milled during World War II when many older mining and milling structures were cannibalized for scrap metal. The last producing mine in the area was the Sunnyside Mine, which ceased production in 1991. The closing of the Sunnyside mine occurred after Lake Emma drained into the mine and out the American Tunnel into Cement Creek in 1978. The flood water from the Lake Emma "blow-out" was reported to have flowed down Cement Creek in a 10-foot wall of water that would have transported a large quantity of tailing and other mine waste down Cement Creek to the Animas River.

  Reclamation activities have been ongoing in the Cement Creek basin since 1991 when tailings were removed from the Lead Carbonate Mill site. Remediation work has also been conducted in Gladstone at the American Tunnel waste dump, Mayflower Mill, Gold King #7 Level Mine, Galena Queen, Hercules Mine, Henrietta Mine, and most recently at the Joe and

John Mine and the Lark Mine in 2006 and 2007. No new reclamation activities have been initiated in 2008 or 2009.

Numerous historic and now abandoned mines exist within a two-mile radius of Gladstone. They include: the Upper Gold King 7 Level, American Tunnel, Grand Mogul, Mogul, Red and Bonita, Evelyne, Henrietta, Joe and John, and Lark mines. Some of these mines have acid mine drainage that flows between 30 and 300 gpm directly or indirectly into Cement Creek and eventually into the Animas River, the confluence located about eight miles downstream of Gladstone. The Animas River Stakeholders Group (ARSG), U.S. Bureau of Land Management (BLM), DRMS and private stakeholders have completed remediation projects at the Evelyne, Henrietta, Joe and John, and Lark mines.

The Red and Bonita Mine is the main focus of this sampling effort, however water quality samples will be collected from the Gold King, Mogul, Grand Mogul and American Tunnel mine adits prior to and after installation of the bulkhead in the Red and Bonita Mine. The site locations are shown on Figure 1. Mine discharges and waste rock piles are the sources of waste at the Red and Bonita Mine. Contaminants are released via oxidation of pyrite within the mine and mine waste pile. Natural dissolution of metal contaminants also occurs in this mineral-rich watershed. Water that flows through the mine and the mine waste pile carries the contaminants to downstream locations via surface water. Water discharged from the site flows to Cement Creek and then to the Animas River, a fishery. Metals generated at the site that are transported via surface water may be attenuated in an adjacent bog and along the flow paths to Cement Creek and the Animas River. There are several additional mines in the area that are also sources of metals to Cement Creek.

Contaminants include low pH and metals. Cadmium concentrations from the mine discharge ranged from 33.3 micrograms per liter (µg/L) to 39.3 µg/L, copper concentrations ranged from 4.5 µg/L to 50.6 µg/L, iron concentrations range from 76,700 µg/L to 97,600 µg/L, lead concentrations ranged from 34 µg/L to 71.2 µg/L, and zinc concentrations ranged from 13,600 µg/L to 17,500 µg/L.

A mine entry was performed during 2012 to investigate the Red and Bonita Mine adit. During the mine entry, precipitates contained within the mine adit to a depth of 2 to 3 feet were disturbed and discharged from the adit, flowed down the tailings pile and along the pathway to Cement Creek, and discharged to Cement Creek. A trail of precipitates was left in the flow path. The disturbance likely caused a release of contaminants greater than would have been discharged had the mine remained undisturbed.

A mine entry was conducted during the week of August 12, 2013. The mine entry was performed to fill data gaps regarding how and where water flows into the mine and where contaminants are generated within the mine. Water treatment, a sedimentation basin, and a filtration system were installed to reduce the potential for discharge of precipitates to Cement Creek during the mine entry.

Another mine entry was also conducted during September 2014 to characterize the properties of the mine for a potential bulkhead location. A packer test was conducted to determine if this location was structurally suitable for a bulkhead that may reduce the

impacts to surface water from the mine discharges. During this event, the water was directed to a retention pond to allow precipitate to settle prior to discharge to the traditional flow path.

The 2015 work is being performed to remove solid precipitates from the mine entrance to approximately 25 feet beyond the proposed bulkhead location. Solids will be transported via the mine discharge to the retention pond where precipitates will settle prior to discharge of water to the traditional path. Once the solids are removed the bulkhead will be installed to eliminate discharge from the Red and Bonita Mine adit.

Background Reference:

- URS Operating Services, Inc. 2010. Red and Bonita Mine Remedial Action Field Sampling Plan. October 2010.
- Weston Solutions Inc., 2014. Sampling and Analysis Plan for Red and Bonita Mine. Nov 2014

Worksheet 11 — Project/Data Quality Objectives

(UFP-QAPP Manual Section 2.6.1)
(EPA 2106-G-05 Section 2.2.6)

11.1 State the Problem

EPA, DRMS, and a third party contractor will install a bulkhead in the Red and Bonita Mine during field season 2015 to eliminate the discharge of metal contaminated water from the mine. Prior to bulkhead installation, a two foot layer of metal precipitate solids must be removed from the floor of the mine from the entrance to a point approximately 25 feet beyond the proposed bulkhead location. The solids will be disturbed and flushed from the mine via the 300 gpm mine discharge and directed toward a settling pond at the base of the waste rock pile where solids will collect for later disposal. When solids are disturbed, the discharge water pH decreases significantly and must be increased to improve solids settling and neutralize water that will be discharged from the site.

EPA has requested that START assist to:

- Develop, help operate, and monitor a water treatment system to increase the pH of adit discharge water and separate solids from the water prior to discharge from the site.
- Document and provide technical assistance for water treatment pond expansion and verify pond dimensions.
- Assist the ERRS removal contractor with operation of the water treatment system during precipitate removal
- Sample adit discharge at the Red and Bonita, Gold King, Mogul, Grand Mogul, and American Tunnel mines prior to sealing of the bulkhead and post bulkhead installation to monitor changes in water quality, metals concentration, and flow rate.
- Document operations associated with bulkhead construction and assist DRMS with monitoring and documenting contractor tasks in accordance with design requirements including underground inspections of the bulkhead construction and concrete testing.

11.2 Identify the Goals of the Study

The goals of the study are to:

- Minimize discharge of particulates discharged from the Red and Bonita Mine site during precipitate removal.
- Evaluate Red and Bonita Gold King, Mogul, Grand Mogul, and American Tunnel adit discharge water quality and flow rates before and after bulkhead installation.
- Document that site activities are conducted in accordance with design requirements.

The primary study questions are:

- What is the immediate effect of bulkhead installation on water quality and flow rates of the Red and Bonita, Gold King, Mogul, Grand Mogul, and American Tunnel?

- Was the settling pond constructed in accordance with plans?
- Is adequate caustic and flocculant being added to ensure effective solids removal in the retention pond? (Interim question during water treatment.)
- Were contaminants released from the site during site activities in excess of what would have occurred if precipitate was left undisturbed?
- Was the precipitate material present in the mine removed adequately?
- Was the bulkhead constructed in accordance with the design plans and specifications?
- What activities occurred at the Red and Bonita site?

11.3 Identify Information Inputs

To support the above objectives, the following data will be collected:

- Analytical results from mine discharge water samples.
- Flow rate measurements of mine discharge water.
- Visual monitoring and field analysis of treatment system influent and effluent and downstream waters. Field analysis may include pH, conductivity, temperature, dissolved oxygen, turbidity, and total suspended solids.
- Results of concrete strength tests and quality documentation.
- Field documentation and photographs of site activities.

11.4 Define the Boundaries of the Study

Spatial Boundaries: The study area includes the Red and Bonita Mine site (Figure 1), including the mine adit and water that flows from the site to Cement Creek and the water flowing from the adits of the Gold King, Mogul, Grand Mogul, and American Tunnel (Figure 1).

Temporal Boundaries: The study will represent conditions immediately before, during, and immediately after the 2015 mine activities scheduled for July through September 2015. A sampling schedule and sampling plan is included in Worksheets 14, 16 and 17.

Practical constraints on data collection: Scheduling adjustments will be made if physical constraints on planned field events occur due to weather, safety considerations, or problems that may impact the technical quality of the measurements.

11.5 Develop the Analytic Approach

Water will be collected from the adit discharges of the Red and Bonita, Gold King, Mogul, Grand Mogul, and American Tunnel mines. Samples will be sent for laboratory analysis of total and dissolved TAL metals. Sampling will occur prior to the initial mine entry and after completion and sealing of the bulkhead.

Flow rate measurements will be collected from the adit discharges of the Red and Bonita, Gold King, Mogul, Grand Mogul, and American Tunnel. Measurements will be taken prior to installation of the bulkhead and after completion and sealing of the bulkhead.

Visual observations and field parameter measurements will be collected periodically in water discharged from the water treatment system toward Cement Creek. It is not anticipated that water quality monitoring data will be directly compared to specific action levels or regulatory limits such as Colorado Water quality standards (WQS) because the data is being collected to document the presence or absence of particulates in discharged water. If the OSC directs that samples be collected from site discharge water, Cement Creek, or the Animas River, the results may be compared to WQS for Animas River Stream Segment 3b (Animas River) or 7 (Cement Creek).

Concrete samples will be collected during the bulkhead concrete pour by a certified concrete testing company. In-field slump testing and air entrapment testing will be conducted to ensure workability and that the concrete meets the design specifications. 3 sets of concrete cylinders will be poured for strength testing every 5 cubic yards of concrete installed; they will be stored as close to the bulkhead as safely possible on a level surface. Two sets will be removed at 7 days for analysis (one set to be tested at 7 days, the other will be laboratory cured and tested 28 days after the concrete pour). The remaining set will be removed and tested 28 days after the concrete pour for in-situ curing conditions.

11.6 Specify Performance or Acceptance Criteria

Total and dissolved metals concentrations in the sampled waters are expected to be high relative to the method detection limits, so standard laboratory reporting limits are considered adequate for the purposes of this data. All data will be reviewed and verified to ensure that they are acceptable for the intended use. Data will be validated at the request of the OSC.

Concrete strength and workability will be measured against the requirements outlined in the bulkhead plans and specifications included as Appendix C.

Decision errors will be limited to the extent practicable by following approved U.S. EPA methods and applicable SOPs listed in Worksheet #21 and Appendix B. Any deviation from the SAP will be documented.

11.7 Develop the Detailed Plan for Obtaining Data

The plans and specifications for the bulkhead are provided as Appendix C.

Field water quality parameters will be obtained using a Horiba water quality meter. Field monitoring will be used to measure the quality of water discharged from the treatment system, with emphasis on pH and turbidity measurements. Visual observations of discharge water clarity will be recorded.

If an uncontrolled release of contaminated water and sediment occurs as indicated by the presence of orange stained precipitates in water leaving the site, water between the treatment system and the discharge to Cement Creek and/or other downstream locations may be sampled at the discretion of the OSC. If samples are collected, data from the laboratories will be delivered in an electronic data deliverable and reported in the Site Activities Report.

Worksheet 17 – Sample Design and Rationale, presents the sampling design, and QAPP

Worksheets 19, 20, 24-28, and 30 specify analysis design requirements. Appendix D provides the Data Management Plan.

Worksheet 14 & 16 —Project Tasks & Schedule

(UFP-QAPP Manual Section 2.8.2)
(EPA 2106-G-05 Section 2.2.4)

Activity	Responsible Party	Planned Start Date	Planned Completion Date	Deliverable(s)	Deliverable Due Date
Develop a Draft SAP and the EPA Region 8 QA Document Review Crosswalk and Operation Plan	WESTON	4/23/2015	5/21/2015	Draft SAP and the Draft EPA Region 8 QA Document Review Crosswalk	5/21/2015
Address EPA comments on Draft SAP and the Draft EPA Region 8 QA Document Review Crosswalk and Operation Plan	WESTON	Upon receipt from EPA	1 week after receipt from EPA	SAP and the Final EPA Region 8 QA Document Review Crosswalk	1 week after receipt from EPA
Develop HASP	WESTON	5/4/2015	5/31/2015	HASP	Prior to Field Work
Site Work/Field Sampling	WESTON	7/6/2015	9/18/2015	NA	NA
Analytical Tasks*	ESAT	7/6/2015	45 Days after final sample submission to analytical lab	Laboratory Reports	To Weston TL: Receipt of analytical results To EPA: with SAR
Quality Control Tasks*	WESTON	7/6/2015	45 Days after final sample submission to analytical lab	Report of Analyses/Data Package; Data Review or Validation	To Weston TL: Receipt of analytical resultsTo EPA: with SAR
Draft Site Activities Report	WESTON	9/21/2015	3 weeks after receipt of concrete testing report and analytical data	Draft Site Activities Report	3 weeks after receipt of analytical results and concrete testing report
Address EPA comments on Draft Report	WESTON	Upon receipt of comments from EPA	One Week after receipt of comments from the EPA	Final Site Activities Report	2 weeks after EPA comments are received.

* If analysis is performed at the request of the OSC

Worksheet 15 — Project Action Limits and Laboratory-Specific Detection/Quantitation Limits

(UFP-QAPP Manual Sections 2.6.2.3 and Figure 15)
(EPA 2106-G-05 Section 2.2.6)

The following information will be provided for each matrix, analyte, analytical method, and concentration level (if applicable).

Matrix: Water
Analytical Method: 200.7, 200.8
Concentration level (if applicable): Low to High

Analyte	PAL[1]	PAL Reference[1]	PQL Goal	Laboratory Quantitation Limit[2]	Laboratory Detection Limit[2]
TAL Metals – Total and Dissolved	NA	NA	CRQL	CRQL	CRQL
Concrete Slump/Air Tests	25 – 30 cm/ 1–3% air	Design Specification	Design Specification	N/A	N/A
Concrete Field and Strength Testing	3,000 psi @ 7 days 3,400 psi @28 days	Design Specification	Design Specification	TBD	TBD

[1] Links to State regulatory cleanup standards are provided in QAPP Appendix D.

[2] Terminology is project/laboratory-specific.

mL/L milliliters per lite

Worksheet 17 — Sampling Design and Rationale

(UFP-QAPP Manual Section 3.1.1)
(EPA 2106-G-05 Section 2.3.1)

START will collect water samples to characterize water quality and flow impacts from bulkhead installation/closure at the Red and Bonita mine. Samples are expected to be collected from the Red and Bonita, Gold King, Mogul, Grand Mogul, and American Tunnel mines both prior to mine entry activities and post bulkhead closure (Figure 3). Water samples for total metals analysis will be placed in a 250 milliliter (mL) poly bottle and preserved with nitric acid to pH ≤ 2. Water samples for dissolved metals analysis will be filtered with a 0.45 µm filter into a 250 mL poly bottle and preserved with nitric acid to pH ≤ 2. Samples will be placed in an iced cooler. Flows will be measured via temporary flume installation, if flows exceed available flume size a Marsh-McBirney flowmeter will be utilized for flow estimates.

Treatment system discharges will be monitored periodically for pH during operation of the treatment system, and other water quality parameters such as conductivity, TDS, and dissolved oxygen will be measured for as long as the additional information is helpful in determining whether the water treatment system is operating as intended. The target pH will be 6 to 7 standard units. Monitoring data will be noted in the field logbook or on field sheets.

While it is not expected at this time, EPA may direct START to collect samples to characterize the quality of water discharged from the treatment system. Samples will be collected and managed as cited for the mine discharge samples.

START will observe and document pond expansion and verify expansion dimensions with a Total Station for capacity and retention time calculations. Dimensions will be recorded in the field logbook or field sheets.

START will document the concrete testing and construction of the bulkhead. A third party testing company will be used to conduct the concrete testing. Requirements for the testing are outlined in the bulkhead plans and specifications (Appendix C).

Sample Identification and Handling

Sampling nomenclature for the bulkhead impacts will follow previous sampling efforts of the Animas Watershed and will be as follows:

Sample ID	Associated Mine	Sample Location Detail / Flow Measurement Detail	Latitude / Longitude
CC01C	Grand Mogul	Sample water from the toe of the waste pile Measure flow from upstream of Cement Creek confluence	37 54 35.72 N 107 37 51.66 W
CC02D	Mogul	Sample water downstream of mine pool at the 3 inch flume Measure flow from the 3" Parshall flume	37 54 36.14 N 107 38 17.26 W
CC03D	Red and Bonita	Sample water at the culvert crossing under the road Measure flow from channel prior to culvert crossing	37 53 48.46 N 107 38 41.61 W
CC06	Gold King 7 Level	Sample water from flow leaving the adit Measure flow from adit channel flume.	37 53 40.50 N 107 38 18.09 W

Worksheet 17 — Sampling Design and Rationale

(UFP-QAPP Manual Section 3.1.1)
(EPA 2106-G-05 Section 2.3.1)

CC18	Cement Creek	Sample water above Gladstone road crossing Measure flow from same area as water sample.	37 53 28.57 N 107 38 57.07 W
CC19	American Tunnel	Sample flow coming out of the ground Measure Flow from same area as water sample.	37 53 27.50 N 107 38 54.39 W

If samples are collected for site discharge during water treatment at Red and Bonita or Gold King for total and dissolved metals they will be labeled RBSW##mmddyyyy-T/D, where ## is the two digit sample number, with the first sample number being 01, and –T and –D indicate whether the sample is for total or dissolved metals analysis.

Concrete cylinder sets for strength testing will be labeled RBC-01 through RBC-06. Slump tests will be identified as RBS-01 through -06. The third party contractor may have different nomenclature requirements; any changes to the nomenclature will be documented in the field logbook or field sheets.

Samples will be analyzed for the parameters listed on Worksheet 15 and Table 1. Requirements for the sample container, volume, preservation, and QC samples are presented in Table 1: Sampling and Analysis Summary and on Worksheet 19 & 30 of the QAPP.

Sampling and analytical activities performed on site will follow all applicable SOPs outlined in Worksheet 21, including EPA ERT SOP 2001 “General Field Sampling Guidelines”. Sampling is anticipated to be performed in Level D personal protective equipment (PPE).

Worksheet 18 — Sampling Locations and Methods

(UFP-QAPP Manual Section 3.1.1 and 3.1.2)
(EPA 2106-G-05 Sections 2.3.1 and 2.3.2)

Sampling Location / ID	Matrix	Depth (units)	Type	Analyte/Analytical Group	Sampling SOP Reference[1]	Comments
Post-treatment samples at discharge from water treatment system and discharge to Cement Creek, if requested by EPA	Water	NA	Grab	Total and Dissolved Metals	2013	Grab sample collected by dipping container in water.
CC01C	Water	NA	Grab	Total and Dissolved Metals	2013	Grab sample collected by dipping container in water.
CC02D	Water	NA	Grab	Total and Dissolved Metals	2013	Grab sample collected by dipping container in water.
CC03D	Water	NA	Grab	Total and Dissolved Metals	2013	Grab sample collected by dipping container in water.
CC06	Water	NA	Grab	Total and Dissolved Metals	2013	Grab sample collected by dipping container in water.
CC18	Water	NA	Grab	Total and Dissolved Metals	2013	Grab sample collected by dipping container in water.
CC19	Water	NA	Grab	Total and Dissolved Metals	2013	Grab sample collected by dipping container in water.
RBS-##	Concrete	NA	Grab	Concrete Slump Test	C143M – 12	Standard Test Method for Slump of Hydraulic-Cement Concrete
	Concrete	NA	Grab	Concrete Air Entrapment	C173M – 14 C231M - 14	Standard Method via Volumetric Method Standard Method via Pressure Method
RBC-##	Concrete	NA	Grab	Concrete Strength	C 31M-98	Standard Practice for Making and Curing Concrete Test Specimens in the Field

[1] Sampling SOPs references will be provided in Worksheet 21.

Worksheet 20 — Field Quality Control Sample Summary

(UFP-QAPP Manual Sections 3.1.1 and 3.1.2.)
(EPA 2106-G-05 Section 2.3.5)

Matrix	Analyte/Analytical Group	No. of Field Samples[1]	No. of Field Duplicates	No. of MS/MSD [2]	No. of Field Blanks	No. of Equip. Blanks	No. of Trip Blanks	No. of Other	Total No. of Samples to Laboratory
Water	Total Metals	6	1	1	1	0	0	0	8 per sampling event
Water	Dissolved Metals	6	1	1	1	0	0	0	8 per sampling event
Concrete	Compressive Strength	6	0	0	0	0	0	0	1 per 5 cy of concrete

[1] Samples that are collected at different depths at the same location, and analyzed separately, will be counted as separate field samples. Even if they are taken from the same container as the parent field sample, MS/MSDs are counted separately, because they are analyzed separately. If composite samples or incremental samples are collected, only the sample that will be analyzed will be included; subsamples and increments will not be listed separately.

[2] Total number of samples to the laboratory does not include MS/MSD samples.

Note: If EPA requests that field samples be collected from treatment system water and analyzed for total and dissolved metals, the need for a duplicate will be determined based on the rationale for sampling. The number and types of QC samples will be based on project-specific DQOs and this worksheet will be adapted, as necessary, to accommodate project-specific requirements. Project-specific QC samples may include field duplicate, field blank, equipment blank, trip blank, field split, MS/MSD, and PT samples and will be collected in accordance with the frequencies recorded on QAPP Worksheet 12.

Quality Assurance Assessment and Corrective Actions are found in QAPP Worksheet #28.

Worksheet 21 — Field SOPs

(UFP-QAPP Manual Section 3.1.2)
(EPA 2106-G-05 Section 2.3.2)

SOP Number or Reference	Title, Revision, Date, and URL (if available)	Originating Organization	SOP Option or Equipment Type (if SOP provides different options)	Modified for Project? Y/N	Comments
2006	Sampling Equipment Decontamination, 6/2011	U.S. EPA, ERT	NA	N	SOPs are available in Appendix B
2013	Surface Water Sampling, 6/2011	U.S. EPA, ERT	NA	N	SOPs are available in Appendix B
G-12	Specifications and Guidance for Contaminant-Free Sample Containers, 12/1992	U.S. EPA, Office of Solid Waste and Emergency Response	NA	N	SOPs are available in Appendix B
2001	General Field Sampling Guidelines, 6/2011	U.S. EPA, ERT	NA	N	SOPs are available in Appendix B
C31M-98	Standard Practice for Making and Curing Concrete Test Specimens in the Field	ASTM	NA	N	SOPs are available in Appendix B
C143M–12	Standard Test Method for Slump of Hydraulic-Cement Concrete	ASTM	NA	N	
C173M–14	Standard Test Method for Air Content of Freshly Mixed Concrete by the Volumetric Method	ASTM	NA	N	
C231M–14	Standard Test Method for Air Content of Freshly Mixed Concrete by the Pressure Method	ASTM	NA	N	

For purposes of this SAP, investigation-derived wastes (IDW) are defined as any byproduct of the field activities that is suspected or known to be contaminated with hazardous substances. The performance of field activities will produce waste products, including spent sampling supplies (disposable scoops) and expendable PPE. IDW will also include soil cuttings and decontamination fluids.

IDW will be managed in accordance with EPA Guide to Management of Investigation Derived Wastes (EPA 1992). Spent sampling supplies and expendable PPE are not anticipated to be considered a hazardous and will be containerized and disposed of in the municipal waste system. Soil cuttings will be returned to the boring or spread around the boring as soon as possible after generation and sampling is complete. Decontamination water will be poured onto the ground close to the boring from which the soil was collected.

Worksheet 22 — Field Equipment Calibration, Maintenance, Testing, and Inspection

(UFP-QAPP Manual Section 3.1.2.4)
(EPA 2106-G-05 Section 2.3.6)

Field Equipment	Calibration Activity	Maintenance Activity	Testing Activity	Inspection Activity	Frequency	Acceptance Criteria	Corrective Action	Title or Position of Responsible Person	Verification	SOP Reference[1]
GPS	Calibrate tape against calibrated steel measuring tape	Clean prior and after each use, check battery	Calibration and operational equipment check	Visually inspect for obvious defects, broken parts, or cleanliness	Prior to use	Equipment operational	Repair/ replace as needed	Field personnel	WAM/COR	Instrument-Specific
Horiba U-50/YSI® 600XLM Water Quality Meters	Calibrate probes with standards per instrument instruction manual	Check batteries, clean probes, store in manufacturer recommended solution	Calibration check	Visually inspect for external damage to probe(s)	Refer to instrument SOP	Refer to instrument SOP	Refer to instrument SOP	Field personnel	WAM/COR	G-13/G-14
Water Flow Instruments	Flume – Measure Size Marsh McBirney – Zero	Flume – clean out upstream debris disturbing laminar flow. Marsh-McBirney – Check Batteries	Flume – N/A Marsh-McBirney – Zero	Flume – Verify flow is through flume not bypassing Marsh-McBirney – Check cables and sensor for wear and tear	Prior to use	Equipment Operational	Flume – Use alternative instrumentation Marsh-McBirney replace batteries/ obtain replacement-	Field Personnel	WAM/COR	Instrument Specific

[1] Refer to Field SOPs (Worksheet 21) and Analytical SOPs (Worksheet 23).

Worksheet 23 — Analytical SOPs

(UFP-QAPP Manual Section 3.2.1)
(EPA 2106-G-05 Section 2.3.4)

Lab SOP Number[1]	Title, Revision Date, and/or Number and URL (if available)	Screening or Definitive Data	Matrix/Analytical Group	SOP Option or Equipment Type	Modified for Project? (Y/N)
TBD	METHOD 6010C INDUCTIVELY COUPLED PLASMA-ATOMIC EMISSION SPECTROMETRY (ICP-AES), 11/2000, http://www.epa.gov/osw/hazard/testmethods/sw846/pdfs/6010c.pdf	Definitive	Water/Soil	ICP-AES	TBD
TBD	METHOD 6020A INDUCTIVELY COUPLED PLASMA-MASS SPECTROMETRY (ICP-MS), 2/2007, http://www.epa.gov/osw/hazard/testmethods/sw846/pdfs/6020a.pdf	Definitive	Water/Soil	ICP-MS	TBD
TBD	C873 / C873M - 10a Standard Test Method for Compressive Strength of Concrete Cylinders Cast in Place in Cylindrical Molds http://www.astm.org/Standards/C873.htm	Definitive	Concrete	Compression Testing Machine	TBD

[1] Lab SOP numbers are lab-specific.

Worksheet 24 — Analytical Instrument Calibration

(UFP-QAPP Manual Section 3.2.2)
(EPA 2106-G-05 Section 2.3.6)

As stated in Worksheet 22, START field personnel are responsible for the calibration of START and sub-contractor provided analytical field equipment. Documented and approved procedures will be used for calibrating, measuring, and testing equipment. Widely accepted procedures, such as those published by U.S. EPA and American National Standards Institute (ANSI), or procedures provided by manufacturers in equipment manuals will be adopted.

The responsibility for the calibration of laboratory equipment rests with the selected laboratories. Each type of instrumentation and each U.S. EPA-approved method have specific requirements for the calibration procedures, depending on the analytes of interest and the sample medium. The calibration procedures and frequencies of the equipment used to perform the analyses will be in accordance with requirements established by the U.S. EPA. The laboratory QA manager will be responsible for ensuring that the laboratory instrumentation is maintained in accordance with specifications. Individual laboratory SOPs will be followed for corrective actions and preventative maintenance frequencies. Laboratory quality control, calibration procedures, corrective action procedures, and instrument preventative maintenance will be included in an addendum to this QAPP once the laboratories have been selected for each sites. Items may include, but are not limited to those identified in the table below.

Instrument	Calibration Procedure	Frequency of Calibration	Acceptance Criteria	Corrective Action (CA)	Title/Position Responsible for CA	SOP Reference[1]
ICP-AES	See 6010C	Calibration and initial calibration verification after instrument set up, then daily; continuing calibration verifications. Upper range within 10%. New upper range limits should be determined whenever a significant change in instrument response or every six months. Low-level continuing calibration verification (LLCCV) standard with 30%.	Initial and continuing calibration verification within ± 10% of upper range true values and ± 30% LLCCV true values.	Inspect system; correct problem; re-run calibration and affected samples	Lab Manager/ Analyst	6010C
ICP/ ICP-MS	See 6010C, 6020A, ISM01.3	Calibration and initial calibration verification after instrument set up, then daily; continuing calibration verification 10% or every 2 hours, whichever is more frequent	Calibration r2 >0.995; initial and continuing calibration verification within ± 20% of true values	Inspect system; correct problem; re-run calibration and affected samples	Lab Manager/ Analyst	6010C, 6020A, ISM01.3

[1] Refer to the Analytical SOPs table (Worksheet 23).

Worksheet 26 & 27 — Sample Handling, Custody, and Disposal

(UFP-QAPP Manual Section 3.3)
(EPA 2106-G-05 Manual Section 2.3.3)

Examples of field form (QAPP Appendix F), chain-of-custody (QAPP Appendix G), and sample label and custody seal (QAPP Appendix H) documentation are in the QAPP. SOPs for sample handling (identified in the table below) are located in QAPP Appendix I.

Sampling Organization: WESTON
Laboratory: EPA Region 8 Laboratory, ESAT, 16194 West 45th Drive, Golden, CO 80033,
Don Goodrich, Goodrich.donald@epa.gov, 303-312-6687; Mark McDaniel, mcdaniel.mark@epa.gov.

Note –The OSC will review and approve the SAP prior to proceeding with lab procurement. Therefore additional information will not be available until the lab procurement has been finalized.

Method of sample delivery (shipper/carrier): Hand delivered or FedEx
Number of days from reporting until sample disposal: 180

Activity	Organization and Title or Position of Person Responsible for the Activity	SOP Reference
Sample Labeling	WESTON Field Personnel	SOP G-1 & G-3
Chain-of-Custody Form Completion	WESTON Field Personnel	SOP G-8
Sample Packaging	WESTON Field Personnel	SOP G-9
Shipping Coordination	WESTON Field Personnel	SOP G-9
Sample Receipt, Inspection, & Log-in	Laboratory Sample Custodian	Laboratory SOP
Sample Custody and Storage	Laboratory Sample Custodian /Laboratory Analytical Personnel	Laboratory SOP
Sample Disposal	Field Personnel/Laboratory Sample Custodian /Laboratory Analytical Personnel	SOP G-1 & G-3/ Laboratory SOP

Supplies and consumables can be received at a WESTON office, U.S. EPA Warehouse or at a site. When supplies are received at a WESTON office or U.S. EPA Warehouse, the PM or PTL will sort the supplies according to vendor, check packing slips against purchase orders, and inspect the condition of all supplies before the supplies are accepted for use on a project. If the supplies do not meet the acceptance criteria, deficiencies will be noted on the packing slip and purchase order. The item will then be returned to the vendor for replacement or repair. Procedures for receiving supplies and consumables in the field are similar to those described above. Upon receipt, items will be inspected by the WESTON PM or PTL against the acceptance criteria. Any deficiencies or problems will be noted in the field logbook, and deficient items will be returned for immediate replacement.

Laboratory Data Deliverables

Worksheet 26 & 27 — Sample Handling, Custody, and Disposal (Continued)

(UFP-QAPP Manual Section 3.3)
(EPA 2106-G-05 Manual Section 2.3.3)

Record	VOCs	SVOCs	PCBs	Pesticides	Metals	Other/ Concrete
Narrative					X	X
COC					X	
Summary Results					X	X
QC Results					X	X
Chromatograms						
Tentatively Identified Compounds						

Data collection activities, including sample collection and data generation, will be verified in accordance with the START IV Program QAPP, Worksheet #35. Data will be reviewed for usability in accordance with the START IV Program QAPP, Worksheet #37.

Worksheet 36 — Data Validation Procedures

(UFP-QAPP Manual Section 5.2.2)
(EPA 2106-G-05 Section 2.5.1)

Data Validator: START

Analytical Group/ Method	Data Deliverable Requirements	Analytical Specifications	MPC	Percent of Data Packages to be Validated	Percent of Raw Data Reviewed	Percent of Results to be Recalculated	Validation Procedure	Validation Code[1]	Electronic Validation Program/ Version
Total and Dissolved Metals	Scribe Compatible EDD	QAPP Worksheet 28	Worksheets 11, 12, 19 & 30	100%	0%	0%	U.S. EPA Stage 2A	SV2aE	N/A

[1] Validation Codes are provided in QAPP Appendix M.

Validation will be performed on all laboratory analytical data unless a defined quantity or percentage of samples is identified by the U.S. EPA in the Technical Direction Document or during the project scoping meeting on a project-specific basis. Project validation criteria as per QAPP Worksheets 12, 15, 19 & 30, 28, and 36, and cited EPA SW-846 methodology will be used. WESTON-contracted laboratory data packages will be verified and validated using a Stage 2A validation, as described in the EPA *Guidance for Labeling Externally Validated Laboratory Analytical Data for Superfund Use* (January 2009) (QAPP Appendix J) unless otherwise specified by the U.S. EPA WAM/COR during the development of the DQOs. Validation Qualifiers will be applied using the following hierarchy: Region 8 UFP-QAPP for Removal Actions and Emergency Responses; the site-specific SAP, and/or QAPP; *EPA National Functional Guidelines for Organic Data Review* (QAPP Appendix K); *EPA National Functional Guidelines for Inorganic Data Review* (QAPP Appendix L); EPA Publication SW-846; and the laboratory-specific SOP. Methods for which no data validation guidelines exist will be validated following the guidance deemed most appropriate by the data validator.

The data validator will receive all laboratory packages and analytical results electronically. Additionally, the validator will be required to submit final validation reports via PDF format and must provide an annotated laboratory analytical result electronic data deliverable (EDD) with applicable data validation qualifiers (QAPP Appendix M) identified in the site-specific SAP, and/or QAPP, and/or result value modifications. The Delegated QA Manager will use EPA document *Using Qualified Data to Document an Observed Release and Observed Contamination* (July 1996) to aid in determining the use of qualified data to document all observed release and observed contamination by chemical analysis under U.S. EPA's HRS. Approved data will be released by the Delegated QA Manager for reporting.

QAPP Worksheet 35 describes the issue resolution process and the individual responsible for conveying results to data users. For issues internal to the laboratory, the laboratory PM will be the responsible party for data resolution issues and will be responsible for conveying this information to the Delegate QA Manager or delegated authority. For external laboratory data and quality issues, the Delegated QA

Manager or delegated authority will provide issue resolution information and will be the responsible party for conveying this information to data users. For quality documents, reports, and field information, the Delegated QA Manager, delegated authority, or other persons identified in the table in QAPP Worksheet 35 will be responsible for issue resolutions of such items and will be the responsible party for conveying that information to data users.

TABLES

Table 1
Sampling and Analysis Summary

Site: Red and Bonita Removal
OSC: Steven Way
TDD: 1502-03

Matrix	Analytical Parameter	Analytical Method	Containers (Numbers, Size, and Type)	Preservation Requirements	Number of Sampling Locations	Number of Field Duplicates	Number of MS/ MSDs[2]	Number of Blanks (Trip, Field, Equip. Rinsate)[1]	Total Number of Samples to Lab[3]	Holding Time
Water	Total Metals	200.7, 200.8	One 250 mL poly bottle	Nitric acid to pH<2	6 per event	1 per event	1 per event	0	7 per event	6 months
Water	Dissolved Metals	200.7, 200.8	One 250 mL poly bottle	Filtered then preserved with nitric acid to pH≤2	6 per event	1 per event	1 per event	0	7 per event	6 months
Concrete	Compressive Strength	C873 / C873M - 10a	Cylinders size TDD	0	6	0	0	0	1 per 5 cy of concrete	Destroyed 7/28 Days

Notes:
[1] Trip blanks are only required for VOCs in water samples.
[2] For the samples designated for MS/MSDs, triple volume is required for VOCs and double volume for other water parameters.
[3] Total number of samples to the laboratory does not include MS/MSD samples.
* Samples will be collected only if requested by the OSC.
°C – Degrees Celsius
MS/MSD – Matrix Spike/Matrix Spike Duplicate
Equip. – Equipment

FIGURES

APPENDICES